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(71) Applicant(s)

Ultronics Limited

(Incorporated in the United Kingdom)

Anson Business Park, Cheltenham Road East,
GLOUCESTER, GL2 9QN, United Kingdom

(72) Inventor(s)

David Franz Lakin

(74) Agent and/or Address for Service

A R Davies & Co

27 Imperial Square, CHELTENHAM, Gloucestershire,
GL50 1RQ, United Kingdom

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(56) Documents Cited

GB 2208715 A

GB 2071853 A

EP 0472108 A2

US 5209121 A

US 4984468 A

US 4934193 A

US 4920805 A

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(54) Pressure sensing device

(57) A pressure sensing device comprises a housing 6 having a pressure port 7 to which hydraulic fluid at pressure is applied, and a further port 9 which is e.g. open to the atmosphere. A sensing diaphragm 5 is mounted by its edges within a chamber in the housing 6 so that its opposite sides face the pressure port 7 and the further port 9 respectively. A fluid-tight seal is provided by an O-ring 11. The diaphragm 5 incorporates a layer 8 of electrically conductive resistive material on one surface of an electrically insulating glass or ceramic substrate 10, the layer 8 being etched or cut away to produce a resistive bridge 12 shaped as shown in Figure 3. In operation the deflection of the diaphragm 5 is sensed by applying a supply voltage to the resistive bridge 12 of the diaphragm 5, and by then detecting the resultant voltage across the resistive bridge 12 in order to provide an electrical signal indicative of the pressure P.

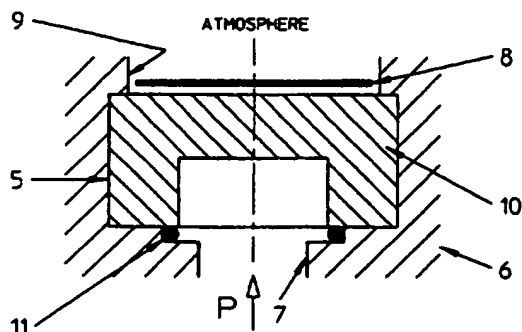


FIG 2.

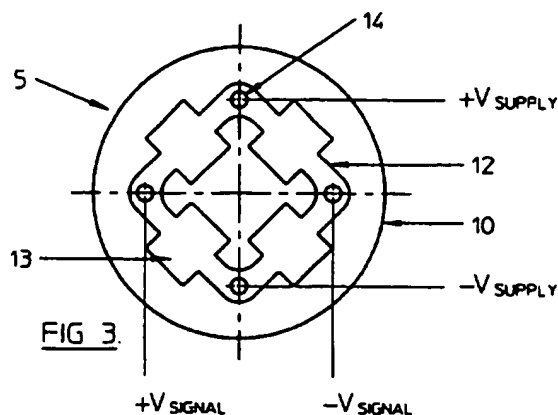


FIG 3.

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PRIOR ART

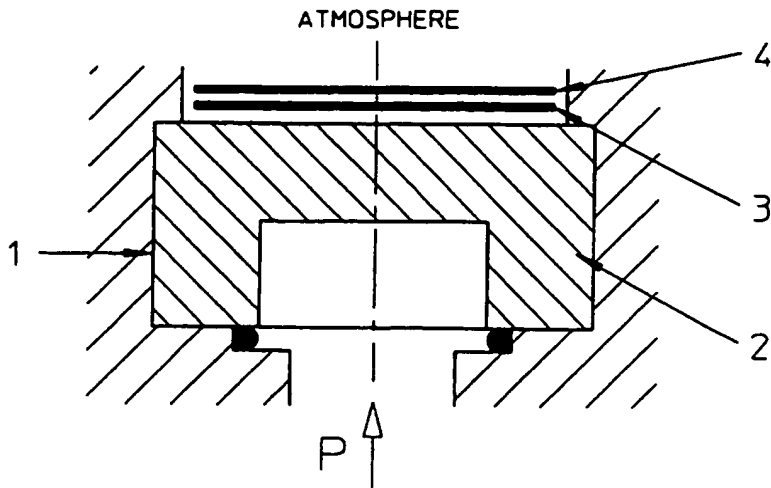


FIG 1.

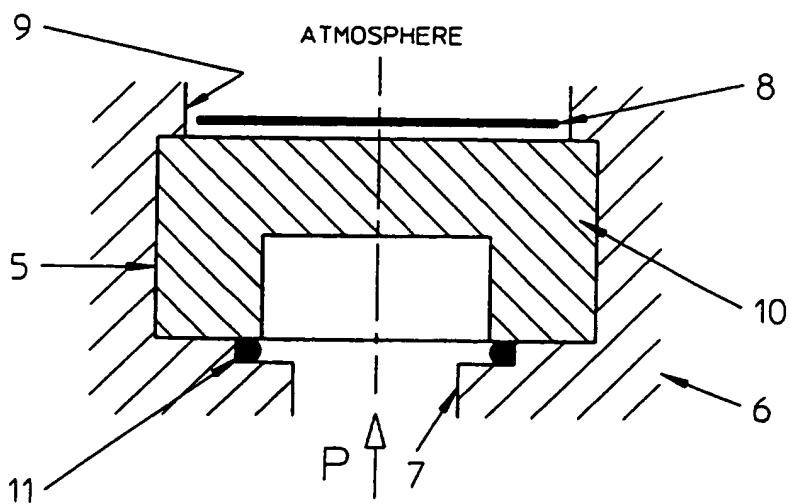


FIG 2.

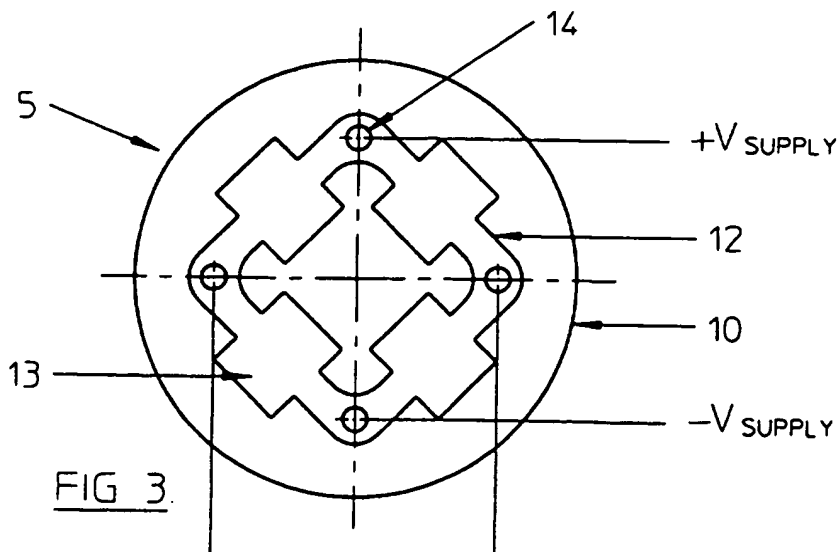


FIG 3.

"Pressure Sensing Devices"

This invention relates to pressure sensing devices.

5 In order to sense the pressure of a hydraulic fluid, it is known to apply the hydraulic fluid to one side of a steel diaphragm to the other side of which an ambient or reference pressure is applied and on which thin films are deposited for the purpose of sensing any deflection of the diaphragm due to the applied hydraulic fluid pressure. In such a prior arrangement, as shown diagrammatically in Figure 1 of the
10 accompanying drawing, the diaphragm 1 is formed by depositing, on a polished steel substrate 2, a thin layer 3 of electrically insulating material, e.g. a glass material, and by then depositing a layer 4 of electrically conductive resistive material on top of the insulating layer 3, the resistive material being cut away (using a laser for example) to form resistors. When the diaphragm is deflected the resistance of such resistors
15 is caused to vary as a result of such deflection, and such variation in resistance may be detected in order to provide an indication of the hydraulic fluid pressure P.

 Whilst such sensors are capable of operating satisfactorily at low temperatures, their accuracy at high temperatures can be compromised to some extent
20 due to variation of the elasticity of the steel substrate.

 It is an object of the invention to provide an improved pressure sensing device.

The present invention is defined by the accompanying claims.

Since such a device has a substrate of electrically insulating material, such as a glass or ceramic material, rather than a steel substrate, it is capable of being
5 formed in such a manner as to exhibit better elastic stability at high temperatures as compared with the known arrangement utilising a steel substrate. Furthermore, since the number of layers in the diaphragm is decreased as compared with the known arrangement, such a device can be produced in a simpler manner and at lower cost.

10 In order that the invention may be more fully understood, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a schematic sectional diagram of the diaphragm of the prior art device;

Figure 2 is a schematic sectional diagram of the diaphragm of a device in
15 accordance with the invention; and

Figure 3 is a view of one side of the diaphragm of Figure 2.

A preferred embodiment of pressure sensing device in accordance with the invention will now be described with reference to Figures 2 and 3. The device
20 comprises a housing 6 having a pressure port 7 to which hydraulic fluid at pressure is applied, and a further port 9 which is open to the atmosphere. A sensing diaphragm 5 is mounted by its edges within a chamber in the housing 6 so that its opposite sides face the pressure port 7 and the further port 9 respectively. A fluid-tight seal is provided by an O-ring 11.

The diaphragm 5 has been formed by directly depositing a layer 8 of electrically conductive resistive material on one surface of an electrically insulating glass or ceramic substrate 10 by a per se known deposition technique, such as plasma vapour deposition, the layer 8 then being etched or cut away (using a laser for example) to produce a resistive bridge 12 shaped as shown in Figure 3. The resistive bridge 12 consists of interlinked areas of resistive material forming four resistors 13 extending between contact pads 14 to which connections to fixed contact pads in the vicinity of the diaphragm are made by means of filaments. The resistors 13 extend in different directions on different parts of the substrate 10, and have resistances which vary in dependence on deflection of the diaphragm. The use of a glass or ceramic substrate to form the diaphragm in this manner enables the diaphragm to be moulded to shape and critical areas to be machined to obtain optimum pressure response.

In operation of the device to sense a hydraulic fluid pressure P , the deflection of the diaphragm 5 is sensed by applying a supply voltage to the resistive bridge 12 of the diaphragm 5, and by then detecting the resultant voltage across the resistive bridge 12 in order to provide an electrical signal indicative of the pressure P .

CLAIMS

1. A pressure sensing device comprising a housing having a pressure port to which hydraulic fluid at pressure is applied, and a sensing diaphragm disposed within
5 a chamber in the housing with which the pressure port communicates such that hydraulic fluid at pressure is applied to one side of the diaphragm, wherein the diaphragm consists of a substrate of electrically insulating material having opposing faces, and a layer of electrically conductive resistive material deposited on at least one of the faces of the substrate and forming at least one resistor having a resistance
10 which varies in dependence on deflection of the diaphragm due to the applied pressure in order to enable an electrical output indicative of the applied pressure to be provided.

2. A device according to claim 1, wherein the substrate is made of a ceramic
15 or glass material.

3. A device according to claim 1 or 2, wherein said at least one resistor extends between contact pads on the diaphragm.

20 4. A device according to claim 3, wherein electrical connections are made from the contact pads to fixed contacts in the vicinity of the diaphragm by means of filaments.

5. A device according to any preceding claim, wherein the layer of resistive

material forms a plurality of resistors extending over different areas of the substrate.

6. A device according to claim 5, wherein the resistors are arranged in a resistance bridge.

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7. A device according to claim 5 or 6, wherein at least some of the resistors extend in different directions.

8. A device according to any preceding claim, wherein said at least one resistor has been formed by depositing the layer of resistive material on the substrate and by then removing selected parts of the layer.

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9. A device according to claim 8, wherein the selected parts of the layer have been removed by laser cutting or etching.

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10. A device according to any preceding claim, wherein the substrate is made of a material exhibiting high elastic stability at high temperatures.

11. A device according to any preceding claim, wherein the arrangement is such that the other side of the diaphragm is subjected to atmospheric pressure.

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12. A pressure sensing device substantially as hereinbefore described with reference to the accompanying drawing.

<p style="text-align: center;"><u>6</u></p> Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9526372.9
Relevant Technical Fields (i) UK Cl (Ed.O) G1N (NAFD3, NAGB3, NAGC3, NAHAT) (ii) Int Cl (Ed.6) G01L 9/04, 9/06 Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Search Examiner M G CLARKE Date of completion of Search 25 JANUARY 1996 Documents considered relevant following a search in respect of Claims :- 1 TO 12

Categories of documents

X: Document indicating lack of novelty or of inventive step.	P: Document published on or after the declared priority date but before the filing date of the present application.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.	E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A: Document indicating technological background and/or state of the art.	&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2208715 A (GULTON INDUSTRIES) whole document	1 to 7 at least
X	GB 2071853 A (ROBERT BOSCH GMBH) whole document	1, 2, 5, 6 at least
X	EP 0472108 A2 (NGK ETC) see especially Figures 15-20 and pages 6, 7	1, 2 at least
X	US 5209121 (ASSIGNED TO PFISTER MESSTECHNIK) whole document (equivalent to EP 0468398 in German)	1, 2, 5, 6 at least
X	US 4984468 (ASSIGNED TO PFISTER GMBH) whole document (equivalent to EP 0394632 in German)	1, 2 at least
X	US 4934193 (ASSIGNED TO BAILEY JAPAN CO LTD) whole document	1, 2, 5, 6 at least
X	US 4920805 (ASSIGNED TO NGK INSULATORS) whole document	1, 2, 10 at least